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Mr. Betchart is a California and Colorado Registered Civil Engineer with over 25 years experience in the water resources and environmental fields. He has performed and managed national, state, regional, and basin-wide planning for water resources, groundwater, and water quality; project-level planning, alternatives analysis, cost estimating, and impact assessment; feasibility studies; licensing/ permitting/ EIS/EIR studies; and conceptual design. Mr. Betchart's project-work emphasis is on problem definition, solution concept development and technical, economic and financial feasibility studies. He is expert at comprehensive analysis of integrated water and environmental planning issues. He is adept at quantitative analyses and modeling of such issues, definition of project objectives and criteria, and analysis of proposed actions relative to economic and other criteria for decision making. He has particular skill in comprehensive review, technical and quantitative assessment and issue resolution in the complex institutional setting associated with water resources, water quality, and environmental issues. Mr. Betchart is experienced at presenting technical material to clients and within integrated planning processes and community relations/ public participation programs. He has been responsible for developing, scoping and managing such planning processes. His masters degree and doctoral studies emphasized water quality and water resources management with minors in mathematics and economics.

Mr. Betchart's planning and design work has addressed pipelines, canals, pumping plants, water treatment plants, tunnels, dams, and hydropower. His experience includes technical leadership for portions of the Water Supply Management Program of East Bay MUD, which was their integrated resource plan developed within an EIS/EIR framework. He has developed plans of study, multi-facility project concepts; innovative conceptual designs; project layouts; project siting reconnaissance studies; hydrologic and hydraulic analyses; water quality and groundwater modeling; water conservation and reclamation studies; surface- and groundwater conjunctive use program development; community water supply programs; environmental data program designs; multi-phase development plans; constructibility assessments; and reliability assessments.

Representative project experience of Mr. Betchart includes :

- **East Bay Municipal Utility District, Updated Water Supply Management Program** -- Engineering screening studies, conceptual designs and planning/analyses in support of EBMUD (Oakland, CA) environmental impact (EIS/EIR) process to select a long-term water supply enhancement program. Responsibilities included task leadership in surface/groundwater conjunctive use site screening and project development and in surface reservoir site screening studies plus conceptual design of other alternatives, cost estimates, and groundwater, water quality, and sediment related impact assessment for short-listed alternatives.
- **Conjunctive Use Studies** -- Mr. Betchart served as technical task leader for EIS/EIR program-level studies to identify/screen suitable areas for conjunctive use (including large potential for water storage in aquifers) and to develop alternative programs for possible inclusion in EBMUD's water supply plans. The Lower Mokelumne River

WR/E - August 22, 1996

WILL B. BETCHART (Page 2)

area (in the vicinity of Lodi) was selected. The study demonstrated the potential for substantial contributions to EBMUD's water supply in a prolonged drought.

Three different conjunctive use program themes were developed: (a) saving surface water for EBMUD use in dry years by switching irrigators to ground water, (b) saving more surface water in dry years by using groundwater for part of the instream flow requirements, and (c) directly using groundwater in dry years for EBMUD water supply. Specific ground-water recharge and withdrawal locations and mechanisms were identified at various program magnitudes for each theme. Intensive groundwater pumping in a sequence of critically dry years was shown to provide a major supplement to surface supply safe yield. Aquifer recharge, storage and conjunctive use was selected as EBMUD's preferred alternative.

- Earthquake Safety Assessment of the Mokelumne Aqueduct San Joaquin Delta Crossing -- Prepared a "Summary of Findings" report on the seismic vulnerability of the aqueduct due to the Delta seismic environment and foundation conditions. The report drew on documentation of a detailed geotechnical investigation of seismic and foundation conditions with special attention to aqueduct levee crossings. A high probability of levee failures due to earthquakes within the next 30 years was noted (based on present understandings) together with significant uncertainties in technical data and relationships that require further study.
- Surface Storage Reservoir Site Screening -- Mr. Betchart served as technical task leader for potential dam/reservoir site identification, conceptual layout of inlet and outlet tunnel/pipeline systems, planning analysis, cost estimation and screening evaluations. Some 94 potential dam and reservoir sites in the San Francisco Bay Area and in the Central California Sierras were identified and evaluated for inclusion on a "short list" of preferred sites carried forward.
- Tunnel Routing Alternatives for Buckhorn Reservoir -- Identified/developed alternative tunnel conceptual designs to avoid major pipeline construction in downtown Moraga.
- **City of Roseville, Folsom Dam Pumping Plant** -- Managed/performed analysis of head losses and pumping capacity for Folsom Project water supply facilities at various reservoir water levels. Analyzed pumping test data to resolve flow measurement discrepancies. Developed conceptual designs, performance analyses and cost estimates to address wide variations in pumping head and demand. Recommended pumping plant expansion by adding two large variable speed pumps to increase capacity. Presently overseeing project design.
- **Sacramento Area Flood Control Agency, Auburn Bridge** -- Identified site for a high Auburn/Highway 49 bridge that allows for potential of future Auburn Dam raise after first phase flood control dam. Corps' proposed bridge is low and incompatible with raise. Developed conceptual design and cost estimate for high bridge and met with stakeholder agencies to work out traffic concerns. Found that acceptable high bridge can be built at approximately same cost as Corps' lower bridge.

WR/E - August 22, 1996

WILL B. BETCHART (Page 3)

- **Sacramento Area Flood Control Agency, Folsom Gate Failure** -- With hydraulic and structural experts, providing peer review services relative to forensic team analysis of Folsom Dam Gate No. 3 failure.
- **Sacramento Area Flood Control Agency, Folsom Dam Reliability** -- With a systems reliability expert, developed a technical approach, scope and budget for conducting a comprehensive reliability analysis of Folsom. The overall objective, as a follow on to the Gate No. 3 failure, would be identification of other vulnerabilities that may result in downstream flooding.
- **Sacramento Area Flood Control Agency, O & M Costs** -- For three alternative flood control plans, reviewed Corps estimates of annual operation, maintenance and replacement costs and suggested substantial revisions. Met with SAFCA and Corps representatives to develop consensus estimates.
- **Sacramento Area Flood Control Agency, Folsom Dam Improvements for Flood Control** -- Managed/performed conceptual design and technical feasibility/reconnaissance studies of potential major modifications to Folsom Dam to enhance flood control (as an alternative to Auburn Dam). Constructibility, while respecting ongoing flood control, water supply, and hydroelectric uses is a major issue for this facility on the American River in California. Work included development of detailed conceptual designs and cost estimates for two main alternatives:
 - Dam Raise -- One improvement examined and found to be feasible is a 30-foot raise of the 350-foot high dam, adding 360,000 acre-feet to its existing 1,000,000 acre-foot reservoir. The dam consists of a 1400 foot long concrete gravity structure across the river channel, extended by embankment wing dams and supplemented by nine additional saddle dams totalling five miles in length. The project would require a challenging schedule to extend the concrete dam and restore adjacent embankments during one dry season. Overall project cost would be approximately \$480 million.
 - High Capacity Discharge Tunnels -- A second improvement examined and also found to be feasible is adding low-level outlet capacity by using up to five large diameter bottom spillway outlet tunnels with upstream orifice controls and wheel gates and a combined capacity exceeding 100,000 cfs in order to quadruple discharge capability during early flood stages and save reservoir storage capacity for the flood peak. The tunnel project would cost approximately \$150 million. Reuse of the existing (presently plugged) construction-period river diversion tunnel was also considered but found to be infeasible because of very high head and constructibility issues.
- **Santa Clara Valley Water District, Coyote Dam Outlet Works Replacement Project** -- Engineering design of a new intake structure, tunnel, outlet channel, and seepage monitoring facilities to replace the existing outlet threatened by siltation. Developed design criteria, civil specifications (including erosion control and other environmental controls and mitigations) and Engineer's cost estimate.

WR/E - August 22, 1996

WILL B. BETCHART (Page 4)

- **Santa Clara Valley Water District, Maple and San Pedro Avenue Recharge Facilities** -- Research, analysis, and recommendations on recharge pond design in response to high lateral and low vertical permeabilities.
- **Stockton East Water District, Groundwater Recharge** -- Managed an evaluation of recharge pond feasibility for land areas adjacent to the Stockton East Water Treatment Plant based on data from subsurface exploration performed previously for treatment plant design and construction.
- **Stockton East Water District, Deer Creek Reconnaissance** -- Managed/performed conceptual design, technical feasibility study and cost estimate for Deer Creek Reservoir, a potential 600,000 to 800,000 acre-foot, off-stream flood control and water supply reservoir in the Sierra Nevada foothills (as a potential alternative to Auburn Dam). Work included diversion facilities and a 135,000 cfs RCC-lined canal to convey flood flows and a 20 MW pumping plant and conveyance canal for water supply storage and delivery.
- **Calaveras County Water District / Northern California Power Agency, North Fork Stanislaus River Hydroelectric Development Project** -- Mr. Betchart coordinated engineering/detailed design for the turnkey contractor's design team on the \$270 million "Calaveras Project" which includes four dams (two over 240-feet high), seven tunnels (one 18 feet in diameter and 7.5 miles long), a vertical shaft (12 feet in diameter and 2200-feet deep), three penstocks (one with pressure greater than 1000 psi) and two powerhouses (five units totaling 257 MW). Responsibilities included writing or reviewing all specifications; managing the resolution of technical problems identified by Owner, Contractor, or Engineer's field representative; coordinating and reviewing design work; coordinating responses to FERC and dam safety agency questions and submittal requirements; managing employees and subcontractors; maintaining schedule; tracking budget; complying with contract scope and securing change orders for out-of-scope work; and being contact point for the Turnkey Contractor and project Owner.
- **County of Sacramento, Department of Environmental Review and Assessment, Draft EIR for Gravel Mining** -- For Aspen VI (Teichert) and Granite Rezoning and Use Permit application, Mr. Betchart provided EIR analysis of environmental setting, impacts, mitigation measures and project alternatives relative to surface and ground-water hydrology and water quality. One issue was flood attenuation impacts on Morrison Creek. Another issue involved TCE and PCE contaminant plumes affecting the proposed mining site, apparently originating from Mather Air Force Base. Impacts addressed included contamination of the gravel resource, contaminated washwater and fines from gravel washing, and health and safety of mine workers.
- **U.S. Environmental Protection Agency, Report to Congress on Water Supply and Wastewater Treatment Coordination** -- Performed technical studies as part of report development on nation-wide water use, ground-water contamination, ground-water overdraft, conjunctive use, wastewater reclamation, water conservation, and small system technology and operation/management needs. The groundwater contamination issue emphasized assessment needs for sites that are potential sources of contaminant plumes. Required consideration of EPA's

WR/E - August 22, 1996

WILL B. BETCHART (Page 5)

coordination needs with other laws including RCRA, TSCA, and FIFRA. The report was used to draft revisions to the Clean Water Act and the Safe Drinking Water Act.

- **U.S. Environmental Protection Agency, "Wastewater Flow Reduction Handbook"** -- As project manager, developed a guide book to identify technical alternatives and economic analysis procedures for building water conservation programs in urban areas. EPA interest was in reducing wastewater flows, but analysis procedures included water supply and energy savings as well. Three case studies were performed (Carbondale, Illinois; Tucson, Arizona and Manteca, California).
- **U.S. Army Corps of Engineers, San Francisco District, Klamath River Basin Plan of Study** -- Performed reconnaissance level planning for Klamath River Basin, Oregon addressing Upper Klamath Lake eutrophication, water quality in Lake Ewauna and the Klamath River, hydropower development on the Klamath River, fish and wildlife, recreation and water supply for agriculture, hydropower, and fisheries.
- **U.S. Army Corps of Engineers, Alaska District, Anchorage Water Resources Plan of Study** -- Prepared detailed plan of study for Corps urban water resources study in Anchorage, Alaska. Issues included issues of urban runoff quality, wastewater disposal/dispersion, and municipal water supply.
- **Upper Mississippi River Basin Commission, Twin Cities Water Plan** -- In Minneapolis-Saint Paul, conducted multi-disciplinary, interagency workshops to apply Water Resource Council's Level B issue-oriented planning guidelines to wastewater disposal, non-point source controls for lakes, water supply, flood control, navigation and recreation problems.
- **Hawaii Department of Natural Resources, Hawaii Water Plan** -- Worked with state and local agency personnel in Hawaii to apply Water Resource Council's Level B issue-focused water planning guidelines. Addressed irrigation efficiency, groundwater quality, basal lens protection and safe yield and non-point source pollution (primarily sedimentation) impacts on coral.

Employment Summary

1990-1996	ESA Consultants Inc. / Earth Sciences Associates Water Resources Engineer and Associate
1985-1990	Calpine Corporation / Electrowatt / Sandwell, Inc. Project Engineer, Senior Water Resources Engineer
1982-1985	Gibbs & Hill, Inc. Project Engineer
1975-1982	INTASA, Inc. Senior Water Resources Engineer

WR/E - August 22, 1996

WILL B. BETCHART (Page 6)

1974-1975	Water Resources Engineers Associate Water Resources Engineer
1973-1974	University of Washington, Department of Civil Engineering Research Assistant Professor
1968-1973	University of Illinois, Urbana-Champaign Campus, Institute for Environmental Studies and Water Resources Center Assistant Research Engineer
Education	B.S., Civil Engineering, University of Colorado, Boulder, 1966 M.S., Civil Engineering (Water Resources/Environmental), University of Colorado, Boulder, 1967 Doctoral Studies, Civil Engineering, University of Illinois, Urbana-Champaign Campus, 1968-1972
Registrations	Registered Professional Engineer (Civil), California, 1981 Registered Professional Engineer, Colorado, 1975
Professional Affiliations	American Society of Civil Engineers American Geophysical Union American Water Resources Association American Water Works Association Association of Ground Water Scientists and Engineers (AGWSE) (formerly National Water Well Association) Groundwater Resources Association of California U.S. Committee on Large Dams Water Environment Federation

WR/E - August 22, 1996